

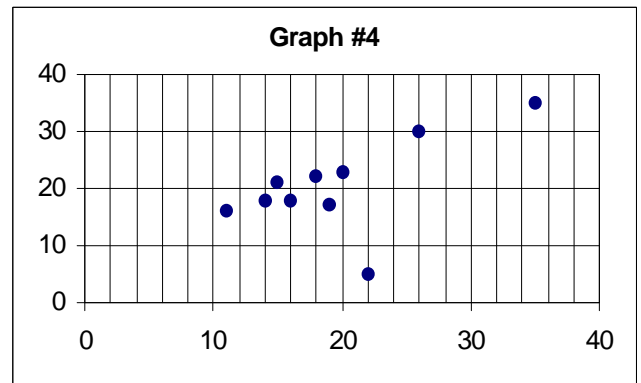
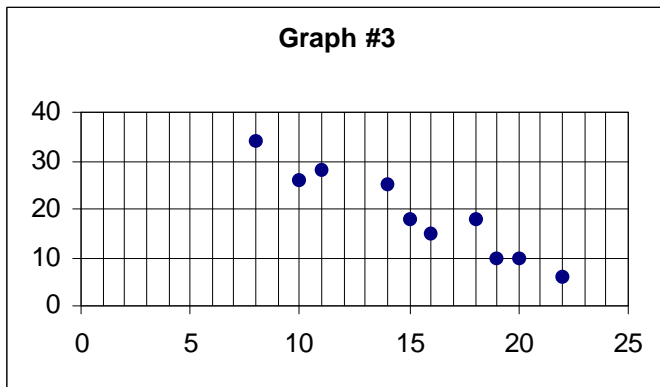
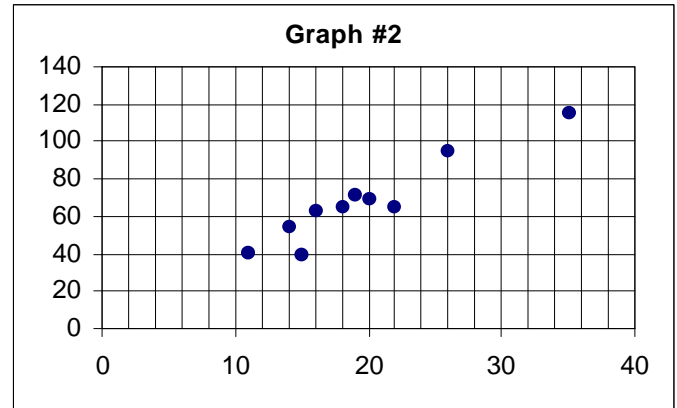
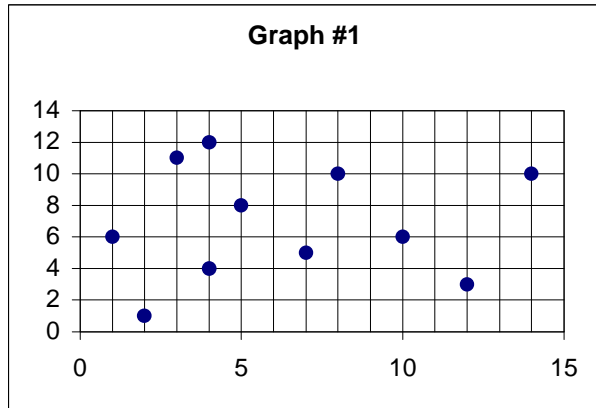
Goal 3: Data Analysis & Probability

Lines of Best Fit

OBJECTIVE	CORE LEARNING GOALS
<ul style="list-style-type: none"> The student will determine if there is an association in a scatter plot of data. The student will display data in charts and graphs and approximate the line of best fit. The student will calculate the line of best fit using a graphing calculator. The student will analyze data through predictions, comparisons, and applications. 	<p>3.2.2 The student will interpret data and/or make predictions by finding and using a line of best fit and by using a given curve of best fit.</p>
<p>DRILL If C represents total monthly charges and v represents the number of videos rented per month, where $C = 1.25v + 3.25$.</p> <ol style="list-style-type: none"> What is the slope of this equation? What does the slope mean in the context of the problem? What is the y-intercept of this equation? What does the y-intercept mean in the context of the problem? 	<p>MATERIALS Activities: “Is There an Association?”, “Biking Home”, “Dentists for the Future”, “Waste Not Want Not” Data Collection Activities Additional Problems Answer Keys Graphing Calculators</p>
<p>CALCULATOR SKILLS Enter data into lists. Graph a scatter plot. Calculate a linear regression. Graph a linear equation.</p>	
<p>ACTIVITIES</p> <ol style="list-style-type: none"> Drill. The drill is a review of the concept of slope and y-intercept in relation to a real-world situation. In this problem the slope represents the change in monthly charges for each additional video that is rented. The y-intercept represents the charge when zero videos are rented. Introduction - Analyzing Scatter plots – Students should follow the instructions on the worksheet and compare their lines of best fit with a partner. One method to determine an association is to draw an oval that includes all the data points. The thinner and more oblong the oval, the stranger the association. Students may disagree on graph #4. Discuss the impact of the outlier (22,5). Exploration – Students may be introduced to finding equations for lines of best fit by using two data points to determine their equation. If they are reading data points from a graph, be sure to emphasize the importance of reading the scales on the x- and y-axis. Students should also be instructed to find a line of best fit using the graphing calculator. Have students work with a partner to answer questions on “Biking Home”. Discuss the limits of using a line of best fit. Complete “Dentists for the Future”. Be sure to review window settings appropriate for the data and how to graph scatter plots and equation on the same graph. Demonstrate how to calculate the line of best fit in the stat menu. Class Discussion – Ask students to explain the equation form $(ax + b)$ and how it relates to $(mx + b)$. Discuss the differences between students’ estimates and the calculated lines of best fit. Additional problems – The data collection activities provided give the students an opportunity to generate and analyze their own data. 	
<p>ASSESSMENT Drill Class discussion Group work</p>	<p>HOMEWORK “Waste Not Want Not”</p>

Is There an Association?

1. Determine which of the following graphs have a positive or negative association or no association.

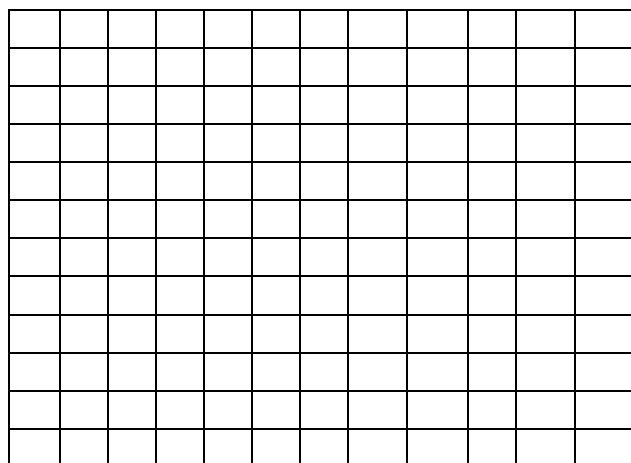


2. On the graphs that appear to have a relationship, draw the line that best fits the data. Compare your answer with your partner.
3. Which data set appears to have the strongest association? Use mathematics to justify your answer.
4. Which data set appears to have an outlier? Use mathematics to justify your answer.

Biking Home

Mike is riding his bike home from his grandmother's house. In the table below, x represents the number of hours Mike has been biking and y represents the number of miles Mike is away from home. Make a scatter plot for this data on the grid below.

Hours (x)	1	2	3	4	5	6	7	8
Miles (y)	35	29	26	20	16	9	6	0



1. Describe the association between the data points on the scatter plot.
2. Use a straightedge to approximate the line of best fit.
3. Using the line, approximate Mike's distance from home after $2\frac{1}{2}$ hours.
4. Select two points on the line. *Read the scale carefully.*
Use the two points to determine the equation of the line in slope-intercept form.
5. What does the slope represent in the context of the problem? What does the y-intercept represent in the context of the problem?
6. Use the equation for your line of best fit to find Mike's distance from home after $2\frac{1}{2}$ hours. Is it the same as your answer in #3? Why or why not?
7. Compare your work with someone else's work. Do you have the same equations? Why are the equations the same/different?
8. Could you use your equation to predict how far Mike would be after 10 hours? Use mathematics to justify your answer.

Biking Home Answer Key

1. The scatter plot has a negative association.
2. Answers may vary.
- 3-4 Answers may vary.
5. Slope represents how fast Mike is riding and y-intercept represents the distance Mike is from home.
6. About 28 miles but answers may vary.
7. Answers may vary.
8. Students should get a negative answer. That might be interpreted as “impossible” or that the biker is now going away from home.

Note: the calculated line is $y = -4.9x + 40$

Dentists for the Future



The Number of Active Dentists in the United States 1980 – 1994
(In thousands)

Year	1980	1985	1989	1990	1991	1992	1993	1994
Number	121	136	144	147	149	152	154	157

Source: Statistical Abstract of the United States, 1997

Everyone values good health—including good dental health. Good dental health depends in part on the availability of good dental care. Will there be enough dentists in the future to keep our teeth healthy?

1. Using the data from the table, make a scatter plot showing the relationship between the year and the number of dentists. Be sure to use an appropriate scale.
2. Describe the pattern of the data points on your scatter plot.
3. Determine an equation for a line of best fit for the data. Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.
4. Graph your equation on your scatter plot.
5. What is the slope of your line? What is the meaning of the slope in the context of the problem?
6. Predict how many dentists there will be in the year 2010. Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.
7. Can you use your line or your equation to determine whether the United States will have enough dentists in the year 2010? Use mathematics to justify your answer. What are some other important considerations that might go into determining whether we will have enough dentists?

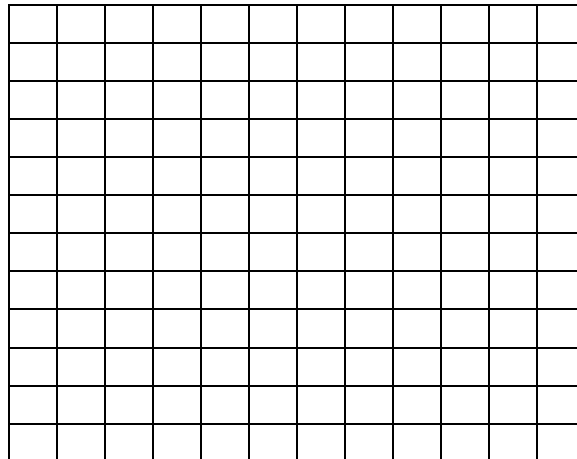
Waste Not Want Not

Below is a list of waste (trash) generated in the United States from 1970 to 1995 as well as the amount of waste recycled.

Waste generated and recycled

Year	Waste Generated (millions of tons)	Waste Recycled (millions of tons)
1970	122	9
1980	152	15
1985	164	16
1990	197	34
1991	197	38
1992	202	41
1993	205	45
1994	210	52
1995	208	56

- Using the data from the table, make a scatter plot on the graph below using the x-axis for waste generated and the y-axis for waste recycled.



- Find an equation for a line of best fit and draw it on the scatter plot.
- Predict the amount of waste recycled for 250 million tons of waste generated. Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.
- Estimate the amount of waste generated for 50 million tons of waste recycled. Use mathematics to explain how you determined your answer. Use words, symbols, or both in your explanation.

Waste Not Want Not

Answer Key

Check scatter plots for appropriate labels, scales, and data points.

Line of best fit: $Y = .5x - 61$

According to my equation, for 250 million ton of waste generated there will be 64 million tons of recycled waste.

Sample explanation: $Y = .5(250) - 61 = 64$

Two hundred twenty two million tons of waste was generated for 50 million tons of waste recycled.

Sample explanation: I found the x value when $y = 50$ on my graph.

Notes for Data Generated Activities

Sizing Up – There is usually no association between height and foot length.
The foot length and forearm length are approximately equal.

Lid Experiment - Number the lids so students can pass them between groups and still be sure they haven't missed a measurement. Have students calculate $L_3 = L_2/L_1$ and look at how close those values are to π .

The Price is Right - Have 10 familiar items with known price. If every answer is correct, the line of best fit is $y = x$. Over estimators will have more points above the line, while under estimators will have more points below the line.

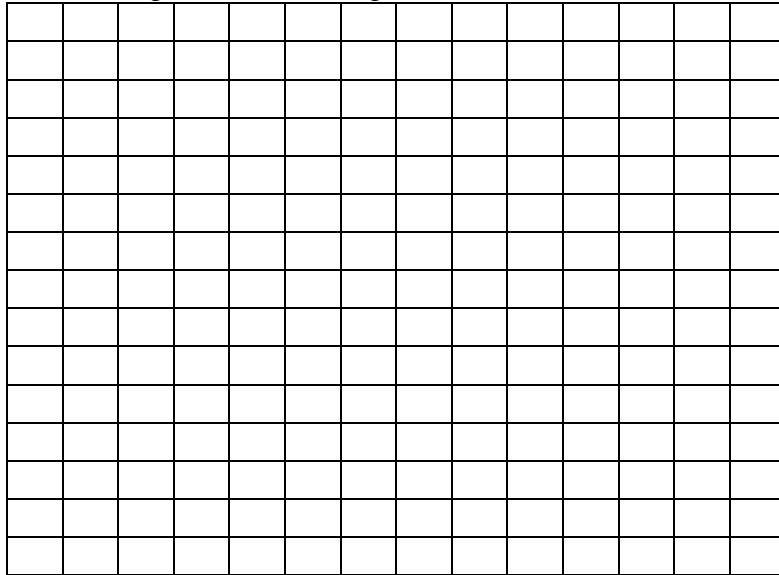
Sizing Up

1. Find the height, foot length, and forearm length (from wrist bone to elbow) for every member of the class. Enter the data in the table below.

[illegible]

2. Make a scatter plot using the height and foot length data on the grid below.

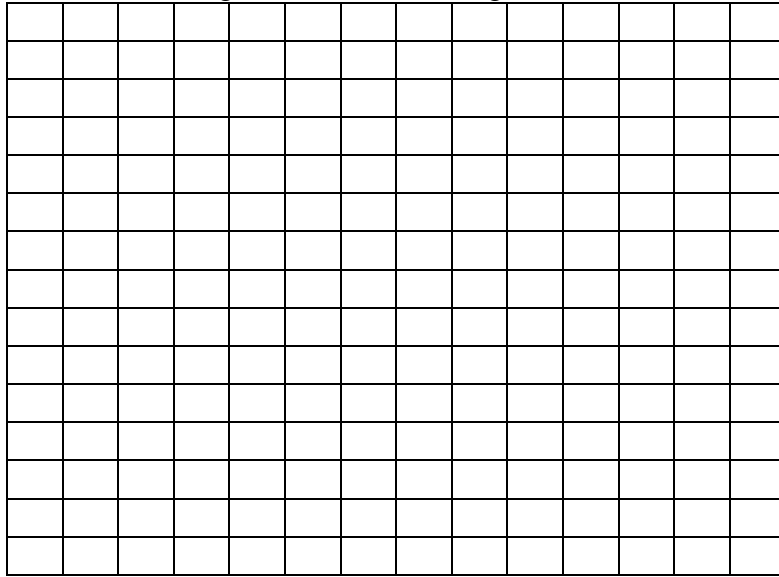
Height and Foot Length



3. Write an equation of a line of best fit and draw the line on the grid above. Use mathematics to explain how you determined your equation. Use words, symbols, or both in your explanation.
4. Substitute your height in for x in the equation and round the foot length to the nearest centimeter. How close is this to your actual foot length?
5. Do you think it would be reasonable to sell shoes by a person's height? Use mathematics to justify your answer.

6. Make a scatter plot using the foot length and forearm length data on the grid below.

Foot Length and Forearm Length



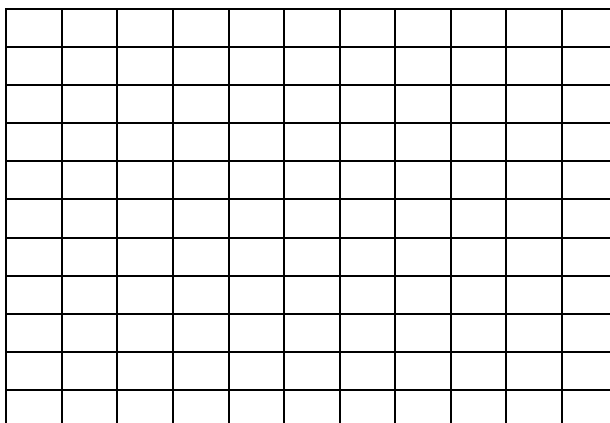
7. Write an equation for a line of best fit and draw the line on the grid above.
8. Comparing the two graphs, which has a stronger association? Use mathematics to justify your answer.
9. According to the Guinness Book of World Records, the tallest person who ever lived was Robert Wadlow, who was 272cm tall. Use your equation to predict Robert's forearm length.

Lid Experiment

1. Find the diameter and circumference of the various lids. Record your results in the table below. Express your answer in decimal form, to the nearest mm.

Diameter (cm)	Circumference (cm)

2. Make scatter plot for the data on the grid below.



3. Use a straight edge to draw a line of best fit for the data.
4. Describe the relationship between the diameter and the circumference of the lids. Use mathematics to justify your answer.
5. Write an equation for the line of best fit.
6. Is this line a good model for this data? Use mathematics to justify your answer.
7. Predict what the diameter of a lid would be if the circumference was 75 cm.
8. The diameter of a quarter is 2.3 cm. Using your equation, determine the circumference of the mold to mint this coin.